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L17	(L13 or l14) and (power adj3 appl$4 adj5 laser)	1	L17
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L15	(file adj format$4) and (matrix adj5 power adfj5 laser adj5 scan$4)	295	L15
L14	(file adj3 format$4) and (matrix adj5 power adfj5 laser adj5 scan$4)	517	L14
L13	(file adj3 format$4) and (matrix same power adfj5 laser adj5 scan$4)	605	L13
L12	(image adj5 whisker) and (laser)	7	L12
L11	(image adj5 whisker) and (creas$3) and (laser)	0	L11
L10	L6 and ((power adj (density or level) adj3 information) and (laser))	0	L10
L9	L6 and ((defin$3 adj pattern adj3 form$3) and (degree adj3 chang$3))	0	L9
L8	L6 and ((power adj level) and (scan$4 adj line) and (laser))	2	L8
L7	L6 and ((power adj (density or level)) and (laser))	6	L7
L6	(pattern and (textile adj (material or fabric or cloths or garment)) and display$3)	493	L6
L5	L1 and ((power adj level) and (scan$4 adj line) and (laser))	2	L5
L4	L1 and ((defin$3 adj pattern adj3 form$3) and (degree adj3 chang$3))	0	L4

L3	L1 and ((power adj (density or level) adj3 information) and (laser))	0	L3
L2	L1 and ((power adj (density or level)) and (laser))	6	L2
L1	(pattern and (textile adj (material or fabric or cloths)) and display$3)	489	L1

END OF SEARCH HISTORY

L16: Entry 1 of 1 File: USPT Jul 25, 1995

DOCUMENT-IDENTIFIER: US 5436027 A
**** See image for Certificate of Correction ****
TITLE: Method of applying a coating design

Abstract Text (1):
A method and apparatus for applying a coating design to selected portions of a surface (13) of a structure (14) including the steps of applying a maskant (18) to the surface (13), positioning a plurality of sensors (20) on the structure (14) around the surface (13), positioning a laser (22) at a distance from the surface (13), directing a laser beam (32) from the laser (22) to each of the sensors (20) as input to the sensors, and using output from the sensors (20) based on the input to determine the position of the laser (22) relative to the surface (13), scanning the perimeter of the selected portions (36) with a laser beam (34), including using the determined relative positions of the laser and the surface to guide the laser beam, to cut into the maskant (18) around the perimeter, peeling the maskant (18) away from the selected portions (36), and applying the coating to the selected portions.

Brief Summary Text (7):
Briefly described, the present invention comprises a method and apparatus for applying a coating design to selected portions of a surface of a structure, wherein the method includes the steps of applying a maskant to the surface, positioning a plurality of sensors on the structure around the surface, and positioning a laser at a distance from the surface. A laser beam from the laser then is directed to each of the sensors as input to the sensors, and output from the sensors based on the input is used to determine the position of the laser relative to the surface. The laser then scans the perimeter of the selected portions of the surface using the determined relative positions of the laser and the surface to guide its laser beam. As the laser scans the surface, the maskant is cut by the laser beam. The cut sections of the maskant then are peeled away from the selected portions of the surface and the coating is applied over the maskant and onto the selected portions.

Brief Summary Text (12):
According to one aspect of the invention, the step of directing a laser beam is performed with a first laser, and the step of scanning the perimeter of the selected portions with a laser beam is performed with a second laser. The second laser is able to generate a more powerful laser beam than the first laser. A lower power first laser is used only for the position-sensing process and not for cutting the maskant and, thus, is safer to use than the high power cutting laser.

Detailed Description Text (9):
A laser, scanner, computer, and controllers are housed in a projector 22, which is mounted on a rollaround cart 24, as shown in FIG. 4. The rollaround cart 24 can be moved and rotated into position confronting the target area 13 of the aircraft, locked down firmly, and raised or lowered as necessary to position its optics in position confronting the target area 13. It is important that the projector 22 be held stationary once the position-sensing and laser-cutting processes are started.

Detailed Description Text (13):
A transform function then is performed to convert the design map of the scan file from a file having coordinates relative to the reference points to a transformed file having coordinates relative to the laser and its scanner. The transformed design map contains the position of each point of the stencil design, along the surface of the target area, relative to the laser and its scanner. The transform function can be performed regardless of the initial positions and orientations of the projector and the target area, so long as the target area is within the scanner's field of view and within a certain distance from the scanner. If desired, the stencil layout on the target area can be previewed before laser cutting by projecting the layout onto the target area using a low laser power setting. This allows any necessary corrections to be made to the stencil's design and/or positioning before actual cutting begins.

Detailed Description Text (14):
As shown in FIG. 5, a cutting laser beam 34 is directed along the perimeter of the stencil or logo design 36 into the maskant 18. In practice, the stencil design 36 would not be visible during laser cutting of the maskant 18. However, for clarity, the design 36 is shown in FIG. 5. The laser beam 34 cuts or ablates the maskant film 18 in a fine line without excessively cutting into the paint base coat. The cutting depth of the laser is controlled by controlling the scan speed of the laser. The faster the scan speed for a given laser power and spot size, the more shallow the laser cutting depth. More than one pass over the stencil outline 36 can be performed in order to obtain a more consistent cut through the maskant 18.

Detailed Description Text (22):
The cutting laser system shown in FIG. 6 utilizes an off-the-shelf dual-axis scanning system 44 with limited-rotation mirrors 46 attached to thermally compensated galvanometer drive motors 48. The dual-axis scanning system 44 is referred to as scanner #2 in subsequent figures. A model XY3037 scanner is used, available from General Scanning, Inc., Watertown, Mass., U.S.A. The optics 42 include either a standard static beam expander 50 or a dynamic focusing lens 52 and an objective lens 54. The dynamic focusing lens 52 changes the focal length in response to a controller, while the laser beam scans 3D contoured targets. This feature is not always needed since the beam's depth of focus oftentimes is long enough to keep the laser spot size on the target within acceptable limits.

Detailed Description Text (25):
The dual-axis scanner #1 is similar to scanner #2 of the cutting laser system. The mirrors of scanner #1 are smaller than the mirrors of scanner #2 due to the lower intensity laser beam of auxiliary laser 60, as well as the less stringent focusing requirements for the auxiliary laser and the need for high speed scanning for visualization. Instead of dynamic focus, the auxiliary laser 60 utilizes an optic telescope 62 in the auxiliary laser beam path 64. Instead of automatic dynamic focusing, the telescope 62 provides for manual focusing to compensate for any large variations in distance from one target to the next. The telescope 62 first expands the beam by some fixed ratio before focusing. This allows for longer focal lengths and/or a more tightly focused spot. Also, the maximum speed for scanner #1 (with a 5 mm pupil) is 3000.degree./sec which equates to 44,000 inches per second at a range of 70 feet.

Detailed Description Text (27):
When the crystal inside the AOM 66 has RF power applied to it from its driver, it refracts a large percentage of the laser beam intensity by a small angle from its original path. The optics are aligned in such a way that only this refracted portion reaches scanner #1, and the rest is directed into a beam stop. Thus, the laser beam appears to be "ON" only when the AOM 66 is energized. This feature also provides an added safety feature in that the projector is failsafe--if power is lost to the projector, and the beam is left stationary, the AOM 66 will also be de-

energized, and will turn "OFF" the laser, even if it still has power.

Detailed Description Text (30):
The position detectors 20 are adapted to receive, as input, an incident laser beam from scanner #1, and based on this input, produce an output signal, which provides an indication to the computer of the position of detectors 20. In this sense, detectors 20 may be sensors, detectors, reflectors, or any other similar device capable of providing a position-indicating output signal for ultimate use by the computer.

Detailed Description Text (33):
FIG. 8 is a side view of the system. The cutting laser 40 and its associated optics 44, 50, 52, 54 are mounted above the auxiliary laser 60 and its associated optics, scanner #1 and elements 66, 72. Scanner #2 is fixed securely a predetermined distance above scanner #1.

Detailed Description Text (44):
The position-sensing system calibrates the position and orientation of the workpiece (airplane) relative to the cutting laser and uses this information to transform the design map into the scanner coordinate system. Since the cutting laser and auxiliary laser (and their scanners) are mounted a fixed distance apart, the preferred method is to determine the position of the target area surface relative to the auxiliary laser scanner #1, then correct for the known distance between the scanners. The system operates at long range (up to about 100 feet), and its accuracy can be fine tuned by adjusting various operating parameters. For aircraft logo painting, positions must be accurate, generally, to 0.1 inch for small logos, up to 0.25 inch for large logos in lateral dimensions, and approximately 1.0 inch in the range dimension.

Detailed Description Text (48):
The preferred position-sensing method involves performing a resectioning 3D transformation to generate a set of scanner positions. The set of scanner positions produces the desired pattern on the workpiece, given those same positions in a 3D drawing or design map. Scanner positions are given in galvanometer (galvo) counts for each of the two mirrors in the scanner. The scanner can be either the auxiliary laser scanner #1 or the cutting laser scanner #2, depending on which laser is being projected.

Detailed Description Text (50):
After the auxiliary laser is centered on a position sensor, its scanner position in galvo counts must be found for this sensor. The coordinates of the reference point locations (calibration points) must be known in the same 3D design map coordinate system as the rest of the pattern points for the design. By manually steering the laser spot with the scanner onto each of the position sensors, the following sequence of steps is performed:

Detailed Description Text (51):
1. The galvo counts corresponding to each position sensor (calibration point) are used to compute the coordinates of the laser beam reflection point (P) and laser beam direction vector (B) in the scanner coordinate system.

Detailed Description Text (56):
x,y,z: Scanner coordinate system. The y axis points horizontally toward the workpiece, coincident with the laser beam with both scanner mirrors centered within their ranges of motion (32768,32768). The z-axis points vertically up from the same origin, and the x-axis points to the right when facing out from the scanner to form a right-handed coordinate system. ##EQU1## a=Offset between the surface of each mirror and its own rotation axis. b=Separation between the two rotation axes.

Detailed Description Text (59):

B=Beam direction vector: the unit vector which describes the direction of the laser beam as it leaves the scanner.

Detailed Description Text (94):
Once the artwork is in 3D form, it is necessary to point sample the individual lines into incremental steps. The laser scanners, being digitally driven, can only project straight lines. Thus, any curves in the artwork (including straight lines mapped onto a contoured surface) must be digitized into steps small enough to eliminate the appearance of jaggedness. Again, this process may be accomplished with software, or by any other desired means, including manual.

Detailed Description Text (95):
The final output of the above two processes (contour mapping and point sampling) is a list of XYZ coordinate points defining the path or the design map for the scanner to follow in projecting the artwork design. In order to put the scan file into a format as specified in the previous section, an automated computer algorithm (or other suitable means) distinguishes between reference points and projectable geometry data points, and makes a count of the total numbers of each. It also distinguishes the points at which one projected entity ends and another begins, counts up the total number of entities, and breaks up the scan file listing appropriately.

Detailed Description Text (99):
In particular, an operator makes any desired changes to operating parameters under the General Setup and Projector Setup menus as prompted by the computer program. Then, the operator uses the Calibrate menu to find the relative positions of each of the detectors. The scan file (if one has been loaded) then will automatically undergo coordinate transformation to transform the detector reference coordinates to scanner coordinates. The scanner (or laser) coordinates comprise a second coordinate reference frame into which the scan file must be transformed. The second reference frame corresponds to the laser and its scanner, and is used to represent the position and orientation of the design map relative to the laser. With the target range calculated, the operator selects Projector Setup again and/or Cutter Setup options if desired to change the projection speed or the cutting speed, respectively.

Detailed Description Text (120):
The status area section on the screen provides information to the user in separate subwindows about the current operating mode, name of the loaded scan file, status of any current calibration sequence, figure of merit (FOM) from the latest relative position calculation, and the current location of the laser spot within the field of the scanner.

Detailed Description Text (140):
The Projector Setup routine provides for selection of the following parameters: step size, step period, scan delay, jump size, jump delay, laser on delay, laser off delay, and scan speed.

Detailed Description Text (142):
The Step Period is an integer in the range 270-65534 (microseconds). This sets the rate at which the scanners increment. The longer the Step Period, the slower the scanner electronics output the steps that compose the "lineto" and "moveto" (Next and Jump) commands. A "lineto" command directs the cutting laser to the next scan point at a lower, cutting speed, while a "moveto" command directs the cutting laser at a faster, non-cutting speed.

Detailed Description Text (143):
The Scan Delay is an integer in the range 2-65534 (microseconds). This sets the settling time for the scanner to wait before execution of a "lineto" command. The longer and faster the previous vector, the longer this settling time needs to be

before execution of the next vector. Jump Size is similar to Step Size, except it is used with "moveto" instead of "lineto" commands. Jump Size is an integer in the range 1-32767. It is normally set significantly larger than the Step Size to make "moveto's" faster than "lineto's". Jump Delay is similar to Scan Delay, except it is used with "moveto" instead of "lineto" commands. Jump Delay is an integer in the range 70-65534 (microseconds). It is normally set larger than the Scan Delay proportionate to the speed ratio of "moveto's" to "lineto's" Laser On Delay is an integer in the range 20-65534 (microseconds). Laser On Delay causes the laser to be turned on slightly after the scanner has begun moving in execution of a "lineto" vector. This is needed since the scanner does not reach its velocity instantly, but ramps up to it with a small delay. Laser Off Delay is an integer in the range 2-65534 (microseconds). Laser Off Delay causes the laser to be turned off slightly after the scanner has completed execution of a "lineto" vector. This is needed because the scanner lags the final endpoint signal from the driver electronics due to the delay caused by the initial ramping process.

Detailed Description Text (149):
Within the FILE menu, a Load File submenu brings up a dialog box containing a list of files that match the current settings of Path and Mask along with their respective sizes in bytes on the disk. This list may be scrolled through using the arrow keys to highlight and select the desired scan file. The current Path and Mask settings are displayed in a header at the top of the dialog box. Also in this header is a field for typing in a file name. File format checking is performed when the file is read in from the disk, and if the proper format is not detected, the file is closed and a message is displayed in the Comment line. If the file was successfully opened and read in the proper format, the file name is displayed in the Status area.

Detailed Description Text (155):
Within the CALIBRATE menu, a Manual submenu is provided. This menu choice turns on the auxiliary laser (via the AOM), and starts a manual calibration sequence in which the user locates each of the reference points on the target area in order. The arrow keys or a mouse/joystick can be used to move the laser spot into the vicinity of the position sensor on the target area. The user then presses either the `Seek Point` or `Set Point` function keys (or mouse buttons) described below. The graphics area on the screen provides an indication of the current location of the laser spot within the scanner's field of view whenever the program is in CALIBRATE mode.

Detailed Description Text (174):
During cutting operations, the cutting laser output is directed into scanner #1. For position sensing, the auxiliary laser 202 output is directed into either of the two scanners via the auxiliary laser selector mirrors 204 and the scanner selector mirror 208. The auxiliary laser selector mirrors 204 are inserted into the beam path 210 with the cutting laser 200 turned OFF in order to direct the auxiliary laser beam into the main beam path. The scanner selector mirror 208 redirects the auxiliary laser beam around scanner #1, into scanner #2, whenever required. The second scanner is used for range triangulation, and is mounted a known distance X from the first scanner along the horizontal x-axis of the scan grid.

Detailed Description Text (197):
Next, the laser scanner mobile cart is moved into the proper position and orientation. Then the computer controller performs the position sensing, scan file transformation, and scanning of the transformed scan file to cut the stencil.

Detailed Description Text (207):
The Position Sense menu choice brings up a graphics screen, which shows the current position of the laser spot within the scan field (a 65535.times.65536 grid). Header information at the top of the screen gives the current spot coordinates, the number of detectors in the array, and the number of the next detector to be located, among

other information. As the user finds each of the detectors, symbols appear on the screen to mark the locations. When all of the detectors in the array have been found, the program calculates the actual physical 3D coordinates of each detector in inches, and returns to the main menu.

CLAIMS:

7. The method of claim 1, wherein the step of directing a laser beam is performed with a first laser, and the step of scanning the perimeter of the selected portions with a laser beam is performed with a second laser, the second laser being able to generate a more powerful laser beam than the first laser.

L7: Entry 3 of 6 File: USPT Oct 3, 1989

DOCUMENT-IDENTIFIER: US 4870727 A
TITLE: Method for detecting anomalies in corduroy preparation

Abstract Text (1):
The apparatus detects corduroy cutter needles coming out of the weft yarn loop channels which are being cut open by the needles, by means of a laser beam scanning about 10 to 20 times a second, transversely across the region where the parallel needles are working. The scanning laser beam creates a diffused light pattern having the general form of a transversely oriented geometric prism, e.g. a cylinder; and a plurality of detector devices determines any variation in the light distribution, as to time and lateral distance, in this scattered or diffused light pattern. A logic circuit carries out and displays the results of the scanning and detecting, and stops the corduroy cutting machine when an emerged needle is detected.

Brief Summary Text (6):
It need not be emphasized that a needle coming outside a loop channel will result in faults in the textile material. These faults, namely uncut rows in the produced corduroy, are immediately visible and depreciate the product.

Brief Summary Text (15):
These objects and still others are met by the invention which, first, provides an apparatus for detecting anomalies in cutting the weft yarn loop rows in the manufacture of corduroy velvet. The apparatus comprises an inspection system for detecting such anomalies without requiring contact with either the material or the needles, comprising a laser-beam scanning unit arranged for projecting a laser beam sweeping substantially at a right angle over the total width of the corduroy web at the location where anomalies are to be detected, and an anomaly detecting device incorporating an integrated logic arrangement and at least one trigger unit for stopping the corduroy cutting machine.

Brief Summary Text (16):
The apparatus further comprises a laser, which is preferably a helium neon laser emitting continuously. The emitted beam is directed to a rotating mirror which creates the horizontal sweep of the beam transversely over the web, at the zone where the outcoming cutting needles are expected. The beam may be divided before sweeping into a number, for example two, of partial beams, each working on a fraction of the width of the web, in order to avoid a too great intensity change during beam sweeping.

Brief Summary Text (18):
The invention further relates to a process for detecting such anomalies; this process comprises projecting at least one transversely sweeping laser beam over the entire width of said web, said beam creating a light band on the zone of the advancing web which is to be inspected for anomalies, said light band producing a light scattering pattern above said zone; monitoring said pattern for intensity changes caused by light reflections from needles emerging from said web or by abnormal light absorption by fabric defects; and translating any anomaly detected during monitoring into a machine stop.

Drawing Description Text (3):
FIG. 2 shows schematically the general arrangement of the laser scanning unit and the detecting devices, relative to the corduroy web, in an embodiment of the invention;

Drawing Description Text (4):
FIG. 3 is a schematic diagram of the laser beam paths to the fabric;

Detailed Description Text (2):
The invention is based on the general principle of the light scattering properties of the textile web surface. In contrast thereto, a needle which has emerged from a loop channel has a distinct reflection pattern, and a fault in the textile web has normally distinctive light absorption properties.

Detailed Description Text (7):
In order to detect such defect, the location of the needles, over the entire width of the web, is scanned by laser light. FIG. 2 schematically shows the general arrangement of the laser unit and the detector unit, in a side view. In FIG. 2, the different items and elements are not necessarily in scale, for the sake of clarity.

Detailed Description Text (9):
A laser scanning device 30 is arranged overhead and directs a scanning beam 32 to that part of the machine where the needles 18 are working within the channels. The laser beam 32 sweeps over the entire width of the web 10, as will be described in more detail later, and a narrow light band can be seen when the web 10 is observed from above. A plurality of horizontally aligned detector units 34--of which only one is shown--is directed with its viewing eye 36 toward the light band produced by the reciprocating laser beam on the corduroy surface. These detector units will also be described later.

Detailed Description Text (10):
Since the corduroy surface being processed is raw, undyed optionally bleached corduroy material, a rather large diffusion zone 38 of irregularly scattered light is established adjacent the surface of the web 10 where the laser beam produces the light band. This diffusion zone 38 has a generally cylindrical form; of course, the limits as shown in FIG. 2 are not sharp and are fundamentally arbitrary since the power density decreases from the impact location of the laser beam on the fabric surface into the surrounding space according to the well known reciprocal square law.

Detailed Description Text (11):
The zone 38 shown in FIG. 2 has not necessarily the represented shape. However, all other possible shapes will be substantially symmetrical with respect to the plane 40 which is at a right angle to the web 10 at the location of the laser light band on the web.

Detailed Description Text (12):
FIG. 3 is a schematic diagram showing the production of the scanning beam. It is to be noted that one of the essentials of the invention is the provision of an energy beam continuously scanning the width of the corduroy web where cutting needles might emerge; in principle, should focusing and energy distribution problems be absent, and further assuming that suitable detectors are available, any energy beam whatsoever could be used, like visible non-coherent light, ultraviolet light, infrared light, as well as invisible energies such as decimeter and centimeter waves, RF waves, etc. For the time being, the laser appears to be the most convenient approach.

Detailed Description Text (13):
In FIG. 3, the housing 30 (see FIG. 2) is schematically represented, and is seen to

include a laser 42. Lasers are well known in the art and need therefore not be described in detail here. The laser which is preferably used is a continuously emitting randomly polarized helium neon laser 42. After a focusing stage (collimator lenses 44, 46), the laser main beam 48 is split, by means of a partially reflecting plane-parallel mirror 50, known per se, into a first partial beam 52 and a second partial beam 54, each one of the two partial beams 52 and 54 representing about 50% of the power of the main beam 48. The second partial beam is deflected by a plane mirror 56 such that the deflected beam 54 will travel in about the same direction as the first partial beam 52, but not necessarily parallel to it. Then, another mirror 58 deflects the second partial beam 54 against a rotating mirror 60, which is shown in FIG. 3 as octagonal. The first partial beam 52 is also reflected by the rotating mirror 60, and after having been reflected thereon, the first partial beam 52 is again deflected on a further plane mirror 62 in order to have its transverse movement in the opposite direction with respect to the transverse movement of the second partial beam 54. The two beams leave the housing 30 by the slot 64 which may be covered by a glass (not shown).

Detailed Description Text (16):
The system alignment procedure consists essentially in the alignment of this unit with respect to the corduroy cutting machine so as to reach the conditions previously outlined. The housing 30 is then rigidly aligned with the machine when placed on it; the laser beam band is aligned with the tips of the needles 18.

Detailed Description Text (17):
Velvet cutting involves generation of a great amount of dust which is effectively exhausted so as to avoid environmental pollution, or at least to limit it to reasonable levels. In order to make the operation of the laser scanning unit feasible in such a situation, a nearly hermetic pressurized housing 30 has been designed. A pressure is created inside the housing by means of a dust filtered cooling fan, and the laser beams are output through a 10 by 275 mm slot in this example.

Detailed Description Text (18):
This unit 30 may be located about 1.6 m above the cloth, and the laser scanning plane forms with the cloth plane an angle alpha of about 60 degrees (see FIG. 2). Each of the two beams 52, 54 scans the web 10 at a rate of about 400 sweeps per second at a speed of about 1.1 km per sec at the center of the web. These parameter values arise from the boundary conditions of the problem and could be changed easily when applying this system to quite a different machine.

Detailed Description Text (19):
On the web there is only one laser spot at a time. The two laser spots from beams 52 and 54 move symmetrically and alternately in opposite directions, each beginning on the web at about one quarter of the distance from one edge and ending after the other edge has been crossed, and then being replaced by a new beam coming from the next facet of the polygonal mirror 60.

Detailed Description Text (22):
The detector device 34 has an operating distance of about 5 to 10 cm above the web 10 in order to correctly detect any change in the intensity distribution within the diffusion or scattering lobe 38. In order to safely avoid any light influence created by true reflection on emerged cutting needles 18A (FIG. 1), the detector optical axis should be substantially parallel to the laser beam plane 32 (FIG. 2).

Detailed Description Text (26):
If the lateral distribution and the spacing of all detecting heads of the device 34 (FIG. 2) is properly selected, e.g. for a distance of 6 cm from the web surface, and a spacing of 8.5 cm between adjacent eyes 36, all curves I on successive heads add up to a flat window-shaped signal, see curve II in FIG. 4B, corresponding to a laser spot travel on the web 10 slightly in excess of the total detector array

length.

Detailed Description Text (27):
This curve II means that the overall sensitivity of the detector array, expressed by the signal add-up, is no longer dependent on the position of the laser spot. The significance of the basic window signal (curve II) will be further explained later.

Detailed Description Text (28):
When the corduroy web is homogeneous and does not present faults or emerged needles, each detector head detect a bell-like curve, created by the travelling laser beam, shown as curve I in FIG. 4A. The overall sum of the signals of all detector heads, over the width D of the web, is the undisturbed window curve II in FIG. 4B. When needle 18A (FIG. 1) in the lateral position X, measured from the left edge O of the corduroy web, has come out of the channel where it cuts, this zone of the corduroy does not contribute to the formation of the diffused scattered lobe 38 (FIG. 2) since the laser light at that zone is reflected in a rather sharply defined direction and does not impinge on a detector. The same effect is obtained when there is a fault in the web; in this case, the light at the respective location is absorbed rather than scattered. In either case, there is a lack of signal, i.e. a defect signal 66, in bell-shaped curve III detected by, for example, the second detector head. Another defect signal 66', of course at the same distance X, is detected in this example by the first detector, which senses the curve III', see FIG. 4C.

Detailed Description Text (38):
Despite the laser scanning unit pressurization, optical components become dusty with prolonged use. Photodiodes also become dusty with use, although they are easily accessible for cleaning. Laser performance degrades with tube age. Polygonal mirror reflectance varies from facet to facet, spreading within a certain range because of random influences or inaccuracies during the coating process. Even the cloth itself can for several reasons slightly change its color. Hence, to compensate for all these events a flat reference signal should be provided, which is tied to light cloud brightness.

Detailed Description Text (39):
On line 80, there appears the bell-shaped signal with embedded needle induced holes, see FIG. 4C. This latter output 80 is used by the motherboard circuitry only from the two heads at positions near the middle of the web, e.g., the two heads 34 shown in FIG. 5, for sampling a spot brightness level just before the laser spot itself crosses the middle of the machine, each such sampling starting the detection process carried out by a respective group of detector heads.

Detailed Description Text (41):
The bandpass filtering transforms the bell-shaped signal into something similar to a one-period sinusoidal signal. Amplitudes are still proportional to the laser spot brightness. The sampling process is started by comparison of this signal with a fixed threshold provided by comparator circuit 88. This comparison on the one hand, and circuit saturations on the other, limit the previously outlined compensation to within a certain range. The two sampled brightness signals are then made available as flat reference signals via lines such as lines 90 and 91, for example, to respective comparators 96 in a plurality of trigger circuits 76, each of which treats a group of head needle signals from detectors on the side to which the brightness signal refers, until a new sweep takes place.

Detailed Description Text (45):
The needed reliability mentioned above is accomplished by means of a rough numerical filtering. That is, in order to stop the machine, it is necessary that the same group of heads detects a needle out of the fabric (i.e. that signal holes exceed the predetermined reference level) during a number of consecutive laser

sweeps. This number is typically in the order of 5 to 20, preferably 16. Every time a sweep fails, one more sweep is needed (the sweep count cannot be negative). As soon as the predetermined count is reached, a stop signal is issued on a global bus 100 (by the closure of the switches 102, in this example), which causes the machine to stop and lock in such a state (a stop-and-lock signal being issued).

Detailed Description Text (57):
Trigger circuit 76 furthermore comprises a distance discriminator 106 to which signals coming from heads 34 are transmitted via bus 108. Circuit 106 detects from which region of the laser beam band on the corduroy surface a stop signal has come and energizes, via line 112, a respective display 110 (only one of them is shown). This may be an LED; of course, its light is to be shielded from photodiode 36. A cancelling circuit (not shown) cancels signals from circuit 106 when the machine is started again.

CLAIMS:

1. A method of detecting web anomalies in a cutting machine for the manufacture of corduroy fabric webs, such as a cutting machine which is operable for advancing a corduroy base web having lengthwise rows of weft yarn loops over a horizontal supporting bar to a plurality of needle-like cutters for introduction of a cutter into each yarn loop to effect severing of the weft rows, the method comprising:

projecting at least one laser beam to sweep over a path that is substantially transverse to the advancing direction of said web, over the total width of the web and at the location where the needle-like cutters are working within the weft yarn loops and the web is being fed to said cutters,

detecting an intensity of light from the laser beam diffused by the web or caused by light reflectance from emergence of one of said needle-like cutters from a respective weft row, of caused by abnormal light absorption by web defects,

detecting changes in said intensity indicative of such anomalies in the web, namely such emergence of cutters or such defects,

generating an anomaly signal in response to such detected changes, for indicating detection of an anomaly in the web; and

generating a signal for stopping the corduroy cutting machine and the advance of the web in response to an anomaly signal.

2. A method according to claim 1, wherein the laser beam is provided by

employing a laser to continuously emit a main beam,

dividing the main beam into two partial beams each representing about 50% of the main beam, and

employing a rotating mirror device to produce two sweeping beams capable of covering the two halves of said web, said two sweeping beams overlapping each other in the middle section of the web and overshooting the edges of the web.

4. A method according to claim 4, including effecting a machine stop when a true anomaly has been detected but avoiding false stops, by considering a predetermined number of laser beam sweeps, each causing an anomaly signal, to define a true anomaly.

6. A method of detecting web anomalies in a cutting machine for the manufacture of corduroy fabric webs, said cutting machine having cutter needles for cutting weft yarn loops of a corduroy fabric web which is fed to said cutter needles, comprising

the steps of:

creating a light band by projecting light toward the portion of the web where the cutter needles are working within the weft yarn loops and the web is being fed to said cutters, thereby producing a light scattering pattern above the zone;

monitoring said pattern for intensity changes caused by anomalies

such as fabric web defects and the emergence of cutter needles from weft yarn loops of the corduroy fabric web; and

stopping said cutting of said corduroy fabric web in response to the detection of any anomaly;

wherein said light band is created by sweeping at least one laser beam transversely over the width of said web; and

wherein the laser beam is provided by

employing a laser to continuously emit a main beam,

dividing the main beam into two partial beams, and

employing a rotating mirror device to produce two sweeping beams capable of covering the two halves of said web, said two sweeping beams overlapping each other in the middle section of the web and overshooting the edges of the web.

7. A method as in claim 6, wherein the light scattering pattern is monitored by detectors which detect the increase and decrease of light intensity produced by the sweeping laser beam, and detect anomalies due to reflection or absorption of light by identifying a defect signal in the curve of increasing and decreasing light intensity.

First Hit Fwd Refs

Generate Collection Print

L12: Entry 5 of 7 File: USPT May 4, 1999

DOCUMENT-IDENTIFIER: US 5899964 A
TITLE: Bending angle detector and straight line extracting device for use therewith and bending angle detecting position setting device

Brief Summary Text (18):
Another problem lies in the process in which an image (a linear projected light image) formed on the surface of the workpiece is photographed by the photographing means and image processing is carried out. In the measurement of the image at the job site, an optimum threshold for binary conversion fluctuates due to the influence of external light and the instability of the light source, so that the shape of the bright zone after the binary conversion varies whenever measurement is carried out. Further, unevenness in the color of the surface of a workpiece or rolling traces inherent to steel plates often cause irregular reflection of beams. This irregular reflection leads to such undesirable situations that (i) the bright zone does not assume the shape of a straight line, (ii) the edge becomes rugged, or (iii) holes B are formed in the bright zone A as shown in FIG. 29, and in these situations, it is difficult to obtain a satisfactorily thin linear image. As a result, the image C which has been thinned by image processing has wavy portions or whisker-like portions (short lines) D which are the cause of errors in extracting a main straight line as shown in FIG. 30.

Detailed Description Text (10):
In the calibration system, as shown in the drawings, a rail 16 used for optical instruments is provided on a base 15 and an optical system 19 comprising a CCD camera 17 and a laser generator 18 is movably placed on the rail 16. A calibration block 20, which serves as a specimen having an given inclination angle, is also movably placed on the rail 16, being a predetermined distance away from the optical system 19. The positions of the optical system 19 and the calibration block 20 are adjustable also in a vertical direction.

Detailed Description Text (11):
In the calibration system as described above, laser light is projected to the calibration block 20 from the laser generator 18 while the calibration block 20 being held at a specified angle .beta. in a specified position and a projected light image formed on the calibration block 20 is photographed by the CCD camera 17. The inclination angle .theta.' and position x (see FIG. 4) of the projected light image in the image plane are calculated and a correction value .delta. for the work angle .theta. is calculated. Then, the calibration block 20 is moved in the direction z (see FIGS. 5 and 6) to take a plurality of positions, and sequential correction values .delta. corresponding to the respective positions are calculated in the same way. Further, while the angle of the calibration block 20 being successively changed, sequential correction values .delta. corresponding to the respective angles are calculated. Based on many data pieces thus obtained, a calibration table is prepared.

Detailed Description Text (13):
S1 to S6: Firstly, the angle .beta. of the calibration block 20 is set to 60.degree.. The calibration block 20 having an angle .beta. of 60.degree. is placed and then moved (backwards) until the image of the laser light (beam) comes to the left end of the image plane (screen). The inclination angle .theta.' (which

corresponds to the block angle .beta.) and position x of the projected light image in the image plane are calculated by image processing and a correction value .delta. corresponding to the inclination angle .theta.' and the position x thus obtained is calculated from equation .delta.=.beta.-tan.sup.-1 (tan .alpha..times.tan .theta.'). The inclination angle .theta.', the position x and the correction value .delta. are stored in the memory 12 (see FIG. 2).

First Hit Fwd Refs

End of Result Set

Generate Collection Print

L12: Entry 7 of 7 File: USPT Jul 29, 1997

DOCUMENT-IDENTIFIER: US 5652805 A

TITLE: Bending angle detector and straight line extracting device for use therewith and bending angle detecting position setting device

Brief Summary Text (18):

Another problem lies in the process in which an image (a linear projected light image) formed on the surface of the workpiece is photographed by the photographing means and image processing is carried out. In the measurement of the image at the job site, an optimum threshold for binary conversion fluctuates due to the influence of external light and the instability of the light source, so that the shape of the bright zone after the binary conversion varies whenever measurement is carried out. Further, unevenness in the color of the surface of a workpiece or rolling traces inherent to steel plates often cause irregular reflection of beams. This irregular reflection leads to such undesirable situations that (i) the bright zone does not assume the shape of a straight line, (ii) the edge becomes rugged, or (iii) holes B are formed in the bright zone A as shown in FIG. 29, and in these situations, it is difficult to obtain a satisfactorily thin linear image. As a result, the image C which has been thinned by image processing has wavy portions or whisker-like portions (short lines) D which are the cause of errors in extracting a main straight line.

Detailed Description Text (10):

In the calibration system, as shown in the drawings, a rail 16 used for optical instruments is provided on a base 15 and an optical system 19 comprising a CCD camera 17 and a laser generator 18 is movably placed on the rail 16. A calibration block 20, which serves as a specimen having an given inclination angle, is also movably placed on the rail 16, being a predetermined distance away from the optical system 19. The positions of the optical system 19 and the calibration block 20 are adjustable also in a vertical direction.

Detailed Description Text (11):

In the calibration system as described above, laser light is projected to the calibration block 20 from the laser generator 18 while the calibration block 20 being held at a specified angle .beta. in a specified position and a projected light image formed on the calibration block 20 is photographed by the CCD camera 17. The inclination angle .theta.' and position x (see FIG. 4) of the projected light image in the image plane are calculated and a correction value .delta. for the work angle .theta. is calculated. Then, the calibration block 20 is moved in the direction z (see FIGS. 5 and 6) to take a plurality of positions, and sequential correction values .delta. corresponding to the respective positions are calculated in the same way. Further, while the angle of the calibration block 20 being successively changed, sequential correction values .delta. corresponding to the respective angles are calculated. Based on many data pieces thus obtained, a calibration table is prepared.

Detailed Description Text (13):

S1 to S6: Firstly, the angle .beta. of the calibration block 20 is set to 60.degree.. The calibration block 20 having an angle .beta. of 60.degree. is placed

and then moved (backwards) until the image of the laser light (beam) comes to the left end of the image plane (screen). The inclination angle .theta.' (which corresponds to the block angle .beta.) and position x of the projected light image in the image plane are calculated by image processing and a correction value .delta. corresponding to the inclination angle .theta.' and the position x thus obtained is calculated from equation .delta.=.beta.-tan.sup.-1 (tan .alpha..times.tan.theta.'). The inclination angle .theta.', the position x and the correction value .delta. are stored in the memory 12 (see FIG. 2).

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Generate Collection Print

L1: Entry 1 of 2 File: USPT Jun 26, 2001

US-PAT-NO: 6252196
DOCUMENT-IDENTIFIER: US 6252196 B1

TITLE: Laser method of scribing graphics

DATE-ISSUED: June 26, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Costin; Darryl	Perrysburg	OH		
Colwell; Heath	Toledo	OH		

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Technolines LLC	Cleveland	OH			02

APPL-NO: 09/ 390956 [PALM]
DATE FILED: September 7, 1999

PARENT-CASE:
CROSS-REFERENCE TO RELATED APPLICATION This is a Divisional of U.S. application Ser. No. 08/729,493 filed Oct. 11, 1996, now U.S. Pat. No. 5,990,444 and claims benefit of Provisional No. 60/102,525 filed Sep. 30, 1998.

INT-CL: [07] B23 K 26/00

US-CL-ISSUED: 219/121.69; 219/121.61, 219/121.68
US-CL-CURRENT: 219/121.69; 219/121.61, 219/121.68

FIELD-OF-SEARCH: 219/121.6, 219/121.61, 219/121.65, 219/121.66, 219/121.67, 219/121.68, 219/121.69, 219/121.72, 219/121.78, 219/121.8, 8/444, 347/253, 430/20

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
3523345	August 1970	Hughes	
3720784	March 1973	Maydan et al.	
4122240	October 1978	Banas et al.	
4271568	June 1981	Durville et al.	

☐	4564739	January 1986	Mattelin	
☐	4589884	May 1986	Gilpatrick	
☐	4629858	December 1986	Kyle	
☐	4680032	July 1987	Arnott	
☐	4680034	July 1987	Arnott	
☐	4780590	October 1988	Griner et al.	
☐	4814259	March 1989	Newman et al.	
☐	4847184	July 1989	Taniguchi et al.	
☐	5017423	May 1991	Bossmann et al.	
☐	5171650	December 1992	Ellis et al.	
☐	5185511	February 1993	Yabu	
☐	5200592	April 1993	Yabu	
☐	5262613	November 1993	Norris et al.	
☐	5341157	August 1994	Campagna et al.	
☐	5404626	April 1995	Bylund et al.	
☐	5567207	October 1996	Lockman et al.	
☐	5990444	November 1999	Costin	219/121.69
☐	6002099	December 1999	Martin et al.	219/121.69

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
3916126	January 1990	DE	
3698302	May 1994	FR	
59-106560	February 1982	JP	
1-95885	April 1989	JP	
3-45578	February 1991	JP	
5-138374	June 1993	JP	

ART-UNIT: 175

PRIMARY-EXAMINER: Evans; Geoffrey S.

ATTY-AGENT-FIRM: Harris, Esq; Scott C.

ABSTRACT:

A laser method scribes graphics on materials. The method relates to the identification and understanding of a new energy measurement called energy density per unit time, and the identification and simultaneous control of the laser operating parameters which influence this energy measurement. Once a range of energy density per unit time is determined for scribing a desired graphic on a given material, the energy density per unit time can be controlled to stay within that range to achieve desired results in a repeatable fashion. In a preferred

embodiment, the invention relates to a method of scribing graphics on fabric, leather and vinyl materials. In this embodiment, the energy density per unit time can be controlled to substantially avoid complete carbonization, melting and/or burnthrough of the material.

16 Claims, 43 Drawing figures

First Hit Fwd Refs

End of Result Set

Generate Collection Print

L1: Entry 2 of 2 File: USPT Nov 23, 1999

US-PAT-NO: 5990444
DOCUMENT-IDENTIFIER: US 5990444 A

TITLE: Laser method and system of scribing graphics

DATE-ISSUED: November 23, 1999

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Costin; Darryl J.	Perrysburg	OH	43551	

APPL-NO: 08/ 729493 [PALM]
DATE FILED: October 11, 1996

PARENT-CASE:
CROSS-REFERENCE TO RELATED APPLICATION This application is a continuation-in-part of pending U.S. application Ser. No. 08/550,339, filed Oct. 30, 1995.

INT-CL: [06] B23 K 26/00

US-CL-ISSUED: 219/121.69; 219/121.61
US-CL-CURRENT: 219/121.69; 219/121.61

FIELD-OF-SEARCH: 219/121.72, 219/121.68, 219/121.69, 219/121.67, 219/121.78, 219/121.8, 219/121.65, 219/121.66, 219/121.6, 219/121.61, 8/444, 347/253, 430/20

PRIOR-ART-DISCLOSED:

U.S. PATENT DOCUMENTS

Search Selected Search ALL Clear

PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
3523345	August 1970	Hughes	28/72.1
3720784	March 1973	Maydan et al.	347/253
4122240	October 1978	Banas et al.	219/121.6
4271568	June 1981	Durville et al.	26/9
4564739	January 1986	Mattelin	219/121.68
4589884	May 1986	Gilpatrick	8/481
4629858	December 1986	Kyle	219/121
4680032	July 1987	Arnott	8/486

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☐	4680034	July 1987	Arnott	8/481
☐	4780590	October 1988	Griner et al.	219/121.8
☐	4814259	March 1989	Newman et al.	430/319
☐	4847184	July 1989	Taniguchi et al.	430/346
☐	5017423	May 1991	Bossmann et al.	428/224
☐	5171650	December 1992	Ellis et al.	430/20
☐	5185511	February 1993	Yabu	219/121.78
☐	5200592	April 1993	Yabu	219/121.67
☐	5262613	November 1993	Norris et al.	219/121.68
☐	5341157	August 1994	Campagna et al.	346/108
☐	5404626	April 1995	Bylund et al.	26/69
☐	5567207	October 1996	Lockman et al.	8/444

FOREIGN PATENT DOCUMENTS

FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	US-CL
2698302	May 1994	FR	
3916126	November 1990	DE	
5 9106-560-A	February 1982	JP	
1-95885	April 1989	JP	
3-45578	February 1991	JP	
5-138374	June 1993	JP	

OTHER PUBLICATIONS

Translation of USSR Inventor's Certificate No. 1,559,794, No Publication Date of Translation.
Excel Control Laser, "Industrial Strength Laser Marking", 1992.

ART-UNIT: 175

PRIMARY-EXAMINER: Evans; Geoffrey S.

ATTY-AGENT-FIRM: Harris, Esq.; Scott C.

ABSTRACT:

A laser method scribes graphics on materials. The method relates to the identification and understanding of a new energy measurement called energy density per unit time, and the identification and simultaneous control of the laser operating parameters which influence this energy measurement. Once a range of energy density per unit time is determined for scribing a desired graphic on a given material, the energy density per unit time can be controlled to stay within that range to achieve desired results in a repeatable fashion. In a preferred embodiment, the material is one of a group of fabric, leather and vinyl materials. In this embodiment, the energy density per unit time can be controlled to substantially avoid complete carbonization, melting and/or burnthrough of the

material.

72 Claims, 43 Drawing figures

129 Profile analyzer or controller:

This subclass is indented under 127.
Subject matter wherein the data processing system or calculating computer measures or controls the transverse physical properties or characteristics (e.g., the thickness distribution, color, moisture content, etc.).

SEE OR SEARCH CLASS:

382, Image Analysis, 108 for an image analysis system designed to examine the color or intensity distribution of an image object.

130 Textile:

This subclass is indented under 117.
Subject matter wherein the particular product involves the manipulation of fibers into fabric.

SEE OR SEARCH CLASS:

19, Textiles: Fiber Preparation, appropriate subclasses, in particular 300 for a control means responsive to a sensed condition or program.

26, Textiles: Cloth Finishing, appropriate subclasses, in particular 74- 79 for web-condition-responsive operation control.

28, Textiles: Manufacturing, appropriate subclasses, in particular 241- 242 and subclasses 248-251 for a control means responsive to a sensed condition.

38, Textiles: Ironing or Smoothing, appropriate subclass, in particular 1- 68 for control of the smoothing process.

57, Textiles: Spinning, Twisting, and Twining, 1- 362 for specific processes and control thereof.

66, Textiles: Knitting, appropriate subclasses for the manufacture of fabric structures from strands by forming loops and drawing the bights thereof through previously formed loops.

68, Textiles: Fluid Treating Apparatus, appropriate subclasses for machines, implements and accessories for fluid treatment of textile fabrics, textile fibers, and pulp.

87, Textiles: Braiding, Netting, and Lace Making, 20 for a textile apparatus with automatic control.

139, Textiles: Weaving, appropriate subclasses for the manufacture of a fabric by a weaving process.

131 Pattern design:

This subclass is indented under 130.
Subject matter wherein the data processing system or calculating computer is responsible for coordinating the information used in

either (1) generating or applying a decorative motif to the fabric or (2) producing a guideline having specific fabric measurements.

132 **For a garment:**

This subclass is indented under 131.
Subject matter wherein the textile product is an article of clothing or apparel.

SEE OR SEARCH CLASS:

2, Apparel, appropriate subclasses for articles of clothing.

83, Cutting, cross reference art collection 901 for apparel collar making and cross reference art collection 905 for buttonhole making.

223, Apparel Apparatus, appropriate subclasses for machines and machine methods of making, repairing, and maintaining in proper condition articles of apparel.

450, Foundation Garments, appropriate subclasses for devices which are specifically designed to fit the human body to protect, compress, support, restrain, or alter the configuration of the body torso or a portion thereof.

133 **Having particular pattern producing operation (e.g., dyeing):**

This subclass is indented under 131.
Subject matter wherein the pattern design is generated by a specific process or technique.

SEE OR SEARCH CLASS:

8, Bleaching and Dyeing; Fluid Treatment and Chemical Modification of Textiles and Fibers, 494 for a dyeing step combined with a nominal textile manufacturing step.

28, Textiles: Manufacturing, 184 for pattern setting and subclasses 214-215 for pile tufting or pattern setting.

66, Textiles: Knitting, 231- 237 for pattern system and subclasses 238-242 for a pattern storage device.

87, Textiles: Braiding, Netting, and Lace Making, 14- 17 for a textile apparatus with a pattern mechanism.

139, Textiles: Weaving, appropriate subclasses for the manufacture of a fabric by a weaving process.

134 **Pattern cutting:**

This subclass is indented under 130.
Subject matter wherein the data processing system or calculating computer is responsible for controlling the cutting procedure for

producing a textile article having specified dimensions.

135 **Pattern matching or positioning:**

This subclass is indented under 130.
Subject matter further comprising a means to align or position a pattern to prevent improper overlap.

136 **Sewing:**

This subclass is indented under 130.
Subject matter wherein the data processing system or calculating computer controls the operation of uniting or ornamenting material by means of a strand inserted (stitched) in the material at spaced locations by a needle and enchained or otherwise locked in position.

SEE OR SEARCH CLASS:

12, Boot and Shoe Making, 7.7 , 9.1, and 13.2 for sewing of shoes.

112, Sewing, 2- 470.36 for sewing manufacturing devices.

137 **Having particular input data (e.g., stitch):**

This subclass is indented under 136.
Subject matter wherein the data processing system or calculating computer further controls the physical characteristics of the sewing operation (e.g., pitch, pattern, location, etc.).

SEE OR SEARCH CLASS:

112, Sewing, 475.17- 475.26 for stitch control.

138 **Embroidering:**

This subclass is indented under 136.
Subject matter wherein the data processing system or calculating computer controls the sewing operation to create a design or ornamental pattern.

SEE OR SEARCH CLASS:

112, Sewing, 78- 103 for embroidering devices.

139 **Spinning or winding (e.g., yarn):**

This subclass is indented under 130.
Subject matter wherein the data processing system or calculating computer controls or monitors the various parameters associated with the textile machines rotational drive or filament being produced.

140 **Loom control:**

This subclass is indented under 130.
Subject matter wherein the data processing system or calculating computer controls an apparatus performing a weaving process.

SEE OR SEARCH CLASS:

139, Textiles: Weaving, 225- 228 and subclass 327 for control of loom.

141 **Knitting:**

This subclass is indented under 130.
Subject matter wherein the data processing system or calculating computer controls an apparatus performing a knitting process.

SEE OR SEARCH CLASS:

66, Textiles: Knitting, appropriate subclasses for the manufacture of fabric structures from strands by forming loops and drawing the bights thereof through previously formed loops.

142 **Fiber preparation:**

This subclass is indented under 130.
Subject matter wherein the data processing system or calculating computer controls the manipulation of raw material for fiber production.

SEE OR SEARCH CLASS:

19, Textiles: Fiber Preparation, appropriate subclasses, in particular 300 for a control means responsive to a sensed condition or program.

143 **Having monitoring or inspecting (e.g., abnormality detection):**

This subclass is indented under 130.
Subject matter wherein the data processing system or calculating computer senses or detects any irregularities or parameters outside of a specified region.

SEE OR SEARCH CLASS:

382, Image Analysis, 141- 152 for an image analysis system designed as a part of an automated inspection system in a product manufacturing environment.

702, Data Processing: Measuring, Calibrating, or Testing, appropriate subclasses for a data processing system or

calculating computer designed for or utilized in measuring, testing, or monitoring.

144 **Yarn quality:**

This subclass is indented under 143.
Subject matter wherein the data processing system or calculating computer senses or detects any discrepancies in the integrity of the stock material's filamen